Turbo Coding Technology Solutions
@ University of South Australia

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The Institute for Telecommunications Research at the University of South Australia has developed very strong capabilities in:

- State of the art Turbo Codec-Modems that operate at very low bit error rates \(< 10^{-10}\), high data rates \(2\text{ Mbit/s}\), using QPSK modulation scheme.

- Single chip Turbo Decoder solutions.

- Expertise in designing turbo coded systems optimised for specific applications (e.g., INTELSAT services)

- Expertise in efficient implementation of turbo decoders.
**Turbo Codec - QPSK Modem**

The Turbo Codec - QPSK Modem is a state of the art satellite receiver/transmitter equipment which was developed under an R&D Contract “Study and Development of a Turbo Codec/Modem for Digital Services” awarded to the Institute for Telecommunications Research by INTELSAT.

The project was executed in collaboration with DSpace Pty Ltd and OKI Techno Centre (Singapore) Pte Ltd.
The **Turbo Codec - QPSK Modem** is designed to work in a closed VSAT network, unframed, with no overhead. The basic model operates at data rates up to 2 Mbit/s and QPSK modulation. The Forward Error Control (FEC) scheme used is a Serial Convolutional Concatenated Scheme that operates at coding rates of 1/2 and 3/4.

- Information data rates (kbit/s): 64, 128, 256, 512, 1024, 2048.
- Bit Error Rate: $< 10^{-10}$
- Measured $E_b/N_0$ for rate 1/2: $< 2.0$ dB
- Measured $E_b/N_0$ for rate 3/4 : $< 3.5$ dB
**Turbo Codec - QPSK Measured Results**

Measured Performance for FEC 1/2

![Graph showing BER vs Eb/No [dB] for Turbo Codec - QPSK Measured Results](image-url)
**Turbo Codec - QPSK Measured Results**

Measured Performance for FEC 3/4

![Graph showing BER vs Eb/No for Turbo Codec - QPSK Measured Results](image-url)

- **BER**
- **Eb/No [dB]**

Values for Eb/No [dB]: 2.5, 2.6, 2.7, 2.8, 2.9, 3, 3.1, 3.2, 3.3, 3.4, 3.5

Values for BER: 1.0E-10, 1.0E-09, 1.0E-08, 1.0E-07, 1.0E-06, 1.0E-05, 1.0E-04, 1.0E-03, 1.0E-02, 1.0E-01, 1.0E-00
The 2nd Australian Communications Theory Workshop, Adelaide, Australia, Feb. 2001

IF loopback measurements, FEC 3/4, QPSK, 2 Mbit/s

**ITR vs COMTECH CDM-550T Performance**

IF loopback measurements, FEC 3/4, QPSK, 2 Mbit/s

Eb/No [dB]

BER

2.5 2.75 3 3.25 3.5 3.75 4 4.25 4.5

ITR (SCCC)

COMTECH (TPC)
Front and Back View
Modulator Specifications:

- Modulation: QPSK
- Data Rates: 64, 128, 256, 512, 1024, 2048 kbit/s
- Rate 1/2 Symbol Rates: 64.5, 129, 258, 516, 1032, 2064 ksym/s
- Rate 3/4 Symbol Rates: 43, 86, 172, 344, 688, 1376 ksym/s
- Output Frequency: 70 MHz
- Output Power: 0 to -30 dBm, ± 0.5 dB
- Rolloff Factor: 0.2, 0.25 or 0.3
## Modulator Specifications:

- **Transmit Filtering:** 44 tap root raised cosine
- **Transmit Frequency stability:** ± 10 PPM standard
- **Timing Jitter:** G.823 & G.824
- **Timing Accuracy:** ± 50 PPM internal clock
- **Output Spurious/Harmonics:** -45 dBC
- **Output Return Loss:** > 14 dB
- **Connector:** BNC, female, 75 Ω (RG59)
Demodulator Specifications:

- Modulation: QPSK
- Data Rates: 64, 128, 256, 512, 1024, 2048 kbit/s
- Rate 1/2 Symbol Rates: 64.5, 129, 258, 516, 1032, 2064 ksym/s
- Rate 3/4 Symbol Rates: 43, 86, 172, 344, 688, 1376 ksym/s
- Input Frequency: 70 MHz
- Input Power: -30 to -55 dBm, ± 0.5 dB
- Rolloff Factor: 0.2, 0.25 or 0.3
Demodulator Specifications:

- Receive Filtering: 48 tap root raised cosine
- Receiver Bandwidth: Max. 3 MHz
- Carrier Acquisition Range: ± 16 kHz
- Timing Tolerance: ± 50 PPM
- Input Return Loss: > 20 dB
- Delay: 30 ms @ 2048 kbit/s, 8 iterations
- Synchronization threshold: 0 dB
General Specifications:

- Single 19” x 3U unit
- Connector: BNC, female, 75 Ω (RG59)
- Graphical User Interface:
  - Runs on a PC under Windows 98
  - Implements all control and monitoring functions
  - Interface via a serial port (RS 232)
- Scrambling: as per INTELSAT IESS 309
General Specifications:

➢ Power Supply:
  • 110V +/- 10% 47/63 Hz
  • 240V +/- 10% 47/63 Hz

➢ Terrestrial Data Interfaces:
  • RS 422, DB37 - RS449 connector
  • NRZ Tx/Rx_Data and Tx/Rx_Clock, BNC connectors
Applications

- Direct-to-Home (DTH) - is the most exciting recent innovation in the television industry that brings TV channels via satellite directly to customers wherever they are located!

- Business Networks - for banking, retailing, news distribution, remote/rural public telecommunications, distance learning

- Closed VSAT Networks offer:
  - availability
  - flexibility
  - reliability
  - very competitive price
  - security